In the Specification

Please amend the first paragraph on page 1 as follows:

TECHNICAL FIELD

~~The present invention~~ This disclosure relates to a steel product suitable for an automobile drive shaft, an automobile constant velocity joint or the like that is to be induction hardened to have a hardened layer on the surface, and to an induction hardened member made of the steel product. The ~~present invention~~ disclosure also relates to methods for manufacturing the steel product and the induction hardened member.

Please amend the second section heading on page 1 as follows:

BACKGROUND ~~ART~~

Please remove the section heading and amend the second full paragraph on page 3 as follows:

~~DISCLOSURE OF THE INVENTION~~

It ~~is an object of the present invention~~ could therefore be advantageous to provide a steel product for induction hardening which allows higher fatigue strength than ever before after induction hardening, and an induction hardened member with high fatigue strength prepared from the steel product. It ~~is another object of the present invention~~ could also be advantageous to provide a method for manufacturing the steel product and the induction hardened member.

Please insert the following section heading and amend the paragraph spanning pages 3 and 4 as follows:

SUMMARY

~~The object can be achieved by providing~~ We provide a steel product for induction hardening that consists of

C: 0.35-0.7 %,

Si: 0.30-1.1 %,

Mn: 0.2-2.0 %,

Al: 0.005-0.25 %,

Ti: 0.005-0.1 %,

Mo: 0.05-0.6 %,

B: 0.0003-0.006 %,

S: 0.06 % or less,

P: 0.02 % or less,

Cr: 0.2 % or less, by mass, and

a balance of Fe and inevitable impurities,

and has a structure of bainite and/or martensite, the total volume fraction of bainite and martensite being 10 % or more,

and

an induction hardened member that is made of the steel product wherein the prior austenite grain size is 12 μm or less through the thickness of a hardened surface layer formed by induction hardening.

Please amend the second section heading on page 5 and the paragraph spanning pages 5 through 7 as follows:

~~EMBODIMENTS OF THE INVENTION~~ DETAILED DESCRIPTION

~~The present inventors~~ We made extensive research for efficiently improving the fatigue strength of a steel product by induction hardening, particularly the torsional fatigue strength as a typical example of the fatigue strength, and obtained the following findings:

(1) Controlling the chemical composition of a steel product within a proper range and adjusting the prior austenite grain size through the thickness of a hardened layer formed by induction hardening to 12 μm or less increase the torsional fatigue strength remarkably. In particular, controlling the Si content and the Mo content within proper ranges increases the number of nucleation sites of austenite during induction hardening, inhibits the grain growth of austenite, and effectively decreases the grain size of the hardened layer, thus increasing the torsional fatigue strength. The addition of 0.30 mass% or more Si is effective in decreasing the prior austenite grain size through the thickness of the hardened layer to 12 μm or less.

(2) Since carbides disperse more finely in bainite or martensite than in ferrite+pearlite, when the total volume fraction of bainite and martensite in a steel product is at least 10 % before induction

hardening, the area of ferrite/carbide interface, which is a nucleation site of austenite during induction heating, increases and thereby the resulting austenite becomes fine. Consequently, this decreases the grain size of the hardened layer, increases the grain boundary strength, and thus increases the torsional fatigue strength.

(3) The prior austenite grain size can consistently be decreased to 12 μm or less through the thickness of the hardened layer by using a steel product having a controlled chemical composition and a controlled structure as described above, and heating the steel product at 800-1000 °C, preferably at 800-950 °C for 5 seconds or less during induction hardening. In particular, the addition of Mo efficiently decreases the grain size of the hardened layer in this heating temperature range. In addition, repetitive induction hardening provides a hardened layer having finer grains than single induction hardening.

Please delete the first full paragraph on page 7 as follows:

~~The present invention is based on these findings and will be described in detail below.~~

Please amend the first full paragraph on page 10 as follows:

As such, Mo plays a very important role ~~in the present invention~~. However, when the Mo content is less than 0.05 mass%, the prior austenite grain size through the thickness of the hardened layer cannot be decreased to 12 μm or less under any condition for manufacturing a steel product and any induction hardening condition. On the other hand, when the Mo content is greater than 0.6 mass%, the hardness of a steel product increases remarkably during rolling. This results in poor workability. Accordingly, the Mo content is limited to 0.05-0.6 mass%, preferably to 0.1-0.6 mass%, and more preferably to 0.3-0.4 mass%.

Please amend the last paragraph on page 17 as follows:

3. Method for manufacturing a steel product for induction hardening

Steel having the above mentioned composition ~~according to the present invention~~ is processed by hot working, such as rolling or forging, into a predetermined shape, and then cooled at an average cooling rate of at least 0.2 °C/s to yield a steel product. This steel product has a structure

of bainite and/or martensite and is suitable for induction hardening, the total volume fraction of bainite and martensite being at least 10 %.

Please amend the second paragraph on page 18 as follows:

4. Method for manufacturing an induction hardened member

The steel product for induction hardening having the composition and the structure as described above ~~according to the present invention~~ is cold rolled, cold forged, or cut, if necessary, and is subjected to induction hardening at least once. The final induction hardening is performed at a heating temperature of 800-1000 °C, preferably at 800-950 °C. The induction hardened member thus manufactured has the prior austenite grain size of 12 μm or less through the thickness of the hardened layer formed on the surface of the steel product and exhibits high torsional fatigue strength.

Please amend the first full paragraph on page 19 as follows:

Fig. 2 shows a relationship between heating temperature of induction hardening and prior austenite grain size of hardened layer in a Mo-bearing steel (Mo: 0.05-0.6 mass%) ~~according to the present invention~~ and a comparative Mo-free steel.

Please amend the third full paragraph on page 22 as follows:

Samples 1-10, 12-23, and 37-52, which were prepared from ~~the~~ steel bars having ~~the~~ <u>our</u> compositions and the structures ~~according to the present invention~~ and were subjected to induction hardening ~~according to the present invention~~, have a grain size of 12 μm or less of the hardened layer and therefore have a torsional fatigue strength of 700 MPa or more.

Please amend the last paragraph spanning pages 23 and 24 as follows:

Sample 24 has a small grain size of the hardened layer. However, ~~the~~ <u>a</u> C content higher than ~~the scope of the present invention~~ <u>our amount</u> results in a low grain boundary strength and a low torsional fatigue strength.

Please amend the four full paragraphs on page 24 as follows:

Samples 25, 26, and 27, which have C, Si, and Mo content lower than ~~the scope of the present invention~~ our amounts, respectively, have a large grain size of the hardened layer and a low torsional fatigue strength.

Samples 28, 29, 30, and 31, which have B, Mn, S and P, and Cr content out of ~~the scope of the present invention~~ our amounts, respectively, have a low grain boundary strength and a low torsional fatigue strength.

Sample 32, which has Ti content higher than ~~the scope of the present invention~~ our amounts, has a low torsional fatigue strength. In contrast, sample 35, which has Ti content lower ~~than the scope of the present invention~~ our amount, has a large grain size of the hardened layer and a low torsional fatigue strength.

Sample 33, in which the heating temperature of induction hardening is higher than ~~the scope of the present invention~~ ours, has a large grain size of the hardened layer. On the other hand, sample 34, in which the heating temperature of induction hardening is lower than ~~the scope of the present invention~~ ours, does not have a hardened layer. Both samples 33 and 34 have a low torsional fatigue strength.

Please amend the last paragraph spanning pages 24 and 25 as follows:

Sample 36 has Si content of 0.28 mass%, which is lower than ~~the scope of the present invention~~ our amount, and a prior austenite grain larger than 12 μm through the thickness of the hardened layer and thus has a low torsional fatigue strength.

Please amend the last paragraph on page 25 as follows:

While the example is described for the torsional fatigue strength, it is needless to say that ~~according to the present invention~~ other fatigue characteristics that involve destruction and crack extension at the prior austenite grain boundary, such as bending fatigue, rolling fatigue, and roller pitting fatigue, are also excellent.